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(54) LOAD BALANCER FOR NETWORK PROCESSOR

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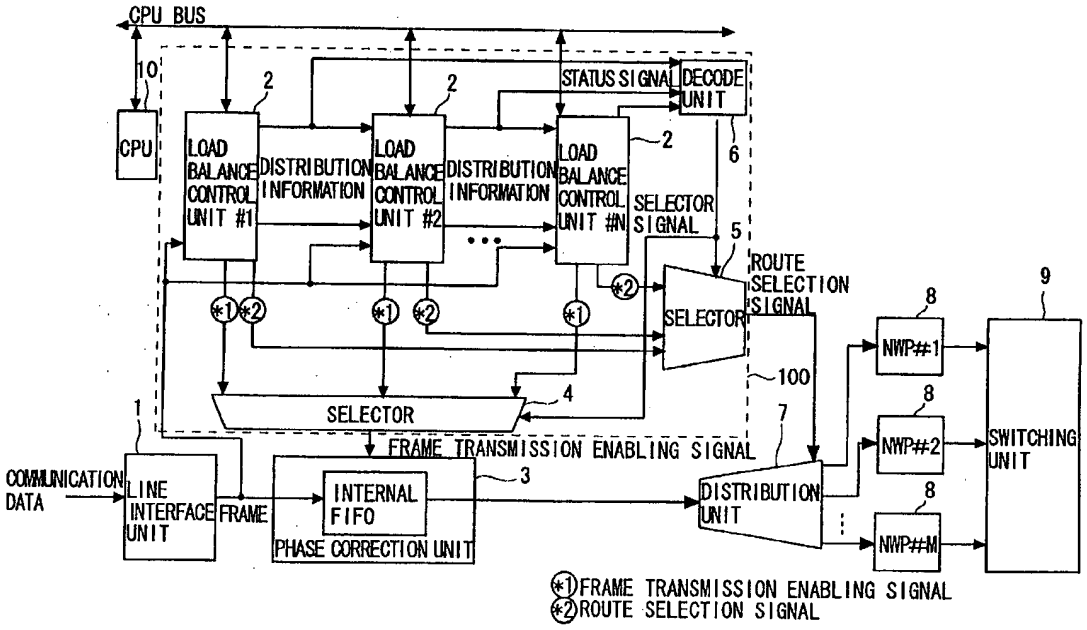
(57) ABSTRACT

A load balancer for a network processor has load balance control units that are multistage-connected in series with each other. When distribution destinations of input information concentrates into a specific network processor by distribution process executed by a load balance control unit, the load balance control unit of next stage execute the distribution process about the input information distributed to the specific network processor.



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TITLE: **Load balancer** for network **processor**

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Abstract Paragraph - ABTX (1):

A **load balancer for a network processor has load balance** control units that are multistage-connected in series with each other. When distribution destinations of input information concentrates into a specific network **processor by distribution process executed by a load balance control unit, the load balance** control unit of next stage execute the distribution process about the input information distributed to the specific network **processor**.

Title - TTL (1):

Load balancer for network **processor**

Summary of Invention Paragraph - BSTX (3):

[0002] The present invention relates to a **load balancer,** applied to a communication device on which a **plurality of network processors** having functions such as routing or address searching are mounted, for performing **load balance** control for frame processes to the respective network **processors**.

Summary of Invention Paragraph - BSTX (5):

[0004] In recent years, with an increase in Internet population, an amount of data processed on the Internet rapidly increases. Accordingly, in a communication device such as a router or a switch, loads relating to a routing and/or **switching process** for a communication frame (packet) such as an IP (Internet Protocol) and the like and a searching process of addresses and the like rapidly increase. For this reason, an improvement in performance of the communication device and an improvement in processing capability are required. Therefore, a network processor, which satisfies a processing capacity required for the communication device must be mounted on the communication device.

Summary of Invention Paragraph - BSTX (6):

[0005] However, the processing capacity of the respective network processors cannot always satisfy requirements based on the rapid increase in the Internet communication. In this case, a **plurality of network processors** having poor processing capacity is mounted on the communication device, and these network processors perform parallel processing. Thus, **load balance** controls to these network **processors** must be performed in order to prevent that the loads given to each of the network **processors** exceed the processing capacity of the respective network **processors**.

Summary of Invention Paragraph - BSTX (7):

[0006] In a conventional technique, when a **load balance** process is performed to network **processors** mounted in parallel to each other, transmission routes are distributed on the basis of information such as the addresses or the like of respective frames, and the frames are transmitted to the respective network

processors. In addition, a plurality of control parameters used when the route distribution is calculated is set in advance. When the eccentricity (imbalance or disproportion) of the distribution such that the distributed frames are concentrated on a specific network processor cause, the destinations of the frame distribution (distribution pattern) are changed into alternative destinations (alternative distribution pattern) at once by changing the control parameters. In this manner, the eccentricity of the frame distribution is solved.

Summary of Invention Paragraph - BSTX (10):

[0008] It is an object of the present invention to provide a **load balancer** for network **processors** in which when distribution destinations of input information are eccentric to a specific network **processor,** the eccentricity can be solved without adversely affecting input information distributed to another network **processor**.

Summary of Invention Paragraph - BSTX (12):

[0010] More specifically, a first aspect of the present invention is a **load balancer** for network **processors**. The **load balancer** is arranged in a communication device including receiving unit and a **plurality of network processors** for performing processes for input information received by the receiving unit. The load balancer includes a plurality of load balance control units. The plurality of load balance control units is multistage-interconnected in series with each other. Each of the **load balance** control units receives the input information from the receiving means and executes distribution processes for distributing the input information to one of the network **processors** according to a predetermined distribution condition per input information. Further, each of the **load balance** control units of the second and subsequent stages supervises a **distribution process executed by the load balance** control unit of the previous stage, and distributes, when distribution destinations of the input information by the **load balance** control unit of the previous stage concentrates into a specific network **processor,** the input information distributed to the specific network **processor by the load balance** control unit of the previous stage to alternative network **processor** according to a distribution condition different from the **distribution condition used in the load balance** control unit of the previous stage.

Summary of Invention Paragraph - BSTX (14):

[0012] The **load balancer** according to the present invention preferably further includes an update control unit which supervises a **distribution process executed by a load balance** control unit of the final stage and updates **distribution conditions used in all the load balance** control units when distribution destinations of the input information by the **load balance** control unit of the final stage concentrates into a specific network **processor**. In this manner, when the eccentricity of the load balance is not solved by using the load balance control units of all the stages, each distribution condition (parameter) of all the load balance control units are automatically updated, and appropriate load balancer can be finally provided for a network form.

Summary of Invention Paragraph - BSTX (15):

[0013] The **load balancer according to the present invention is preferably constituted such that each of the load balance** control units distributes the input information received from the receiving means to a predetermined network

processor without executing the distribution processes. In this manner, a function that efficiently performs development evaluation can be added to the load balancer according to the present invention.

Summary of Invention Paragraph - BSTX (16):

[0014] A load balancer according to the present invention is preferably constituted such that each of the load balance control units changes, when a failure caused on one of the plurality of network processors, a distribution conditions used on the distribution process into alternative distribution condition corresponding to distribution destinations except for the network processor having the failure. In this manner, the load balancer also includes a function of continuing optimum load balance control even in generation of a trouble, so that the reliability of the entire load balance system can be improved.

Summary of Invention Paragraph - BSTX (17):

[0015] A second aspect of the present invention is a communication device. The communication device includes receiving unit, a plurality of network processors for performing processes for input information received by the receiving unit, and a load balancer. The load balancer includes a plurality of load balance control units that are multistage-connected in series with each other. Each of the load balance control units receives the input information from the receiving means and executes distribution processes for distributing the input information to one of the network processors according to a predetermined distribution condition per input information. Further, each of the load balance control units of the second and subsequent stages supervises a distribution process executed by the load balance control unit of the previous stage, and distributes, when distribution destinations of the input information by the load balance control unit of the previous stage concentrates into a specific network processor, the input information distributed to the specific network processor by the load balance control unit of the previous stage to alternative network processor according to a distribution condition different from the distribution condition used in the load balance control unit of the previous stage.

Summary of Invention Paragraph - BSTX (19):

[0017] A third aspect of the present invention is a communication device. The communication device includes receiving means, a plurality of network processors for performing processes for input information received by the receiving means, and a plurality of load balancers. Each of the load balancers includes a plurality of load balance control units that are multistage-connected in series with each other. Each of the load balance control units receives the input information from the receiving unit and executes distribution processes for distributing the input information to one of the network processors according to a predetermined distribution condition per input information, and each of the load balance control units of the second and subsequent stages supervises a distribution process executed by the load balance control unit of the previous stage, and distributes, when distribution destinations of the input information by the load balance control unit of the previous stage concentrates into a specific network processor, the input information distributed to the specific network processor by the load balance control unit of the previous stage to alternative network processor according to a distribution condition different from the distribution condition used in the load balance control unit of the previous stage. When one of the load

balancers is used as an active-system and the other load balancers serve as standby-systems, distribution conditions which are being used in the plurality of load balance control units included in the load balancer serving as the active-system are set in the load balance control units included in the load balancers serving as the standby-systems.

Detail Description Paragraph - DETX (5):

[0038] In FIG. 1, as main constituent elements of the communication device, a line interface unit 1 serving as a receiving means, the **load balancer** 100, a phase correction unit 3, a distribution unit 7, a **plurality of network processors** (to be referred to as "NWPs" hereinafter) 8, a switching unit (to be referred to as an "SW" hereinafter) 9, and a CPU 10 serving as a control means.

Detail Description Paragraph - DETX (11):

[0044] The SW 9 performs a **switching process** of frames by using the routing headers or the like added to frames input from the NWPs 8. The CPU 10 performs various settings to a load balance control unit 2 in the load balancer 100 through a CPU bus.

Detail Description Paragraph - DETX (120):

[0153] As the third modification, a display device (display) serving as a display means is connected to a CPU bus. As **distribution conditions used in load balance** control units which execute distribution processes, as distribution states of input information to network **processors,** and as the number of **load balance** control units which are set in such states that distribution processes are executed, frame **distribution statuses obtained by the load balance** control units 2 of the respective stages, a ratio of distributions to respective routes, the numbers of transmission frames in units of routes, a **load balance** control unit which is set in an ON state at present, a generation polynomial which is selected at present, and the like may be displayed on the display such that the CPU 10 executes software.

Claims Text - CLTX (2):

1. A **load balancer** for a network **processor comprising: a plurality of load balance** control units arranged in a communication device including receiving means and a **plurality of network processors** for performing processes for input information received by the receiving means, wherein the plurality of **load balance** control units are multistage-interconnected in series with each other, each of the **load balance** control units receives the input information from the receiving means and executes distribution processes for distributing the input information to one of the network **processors** according to a predetermined distribution condition per input information, and each of the **load balance** control units of the second and subsequent stages supervises a **distribution process executed by the load balance** control unit of the previous stage, and distributes, when distribution destinations of the input information by the **load balance** control unit of the previous stage concentrates into a specific network **processor,** the input information distributed to the specific network **processor by the load balance** control unit of the previous stage to alternative network **processor** according to a distribution condition different from the **distribution condition used in the load balance** control unit of the previous stage.

Claims Text - CLTX (3):

2. The **load balancer** according to claim 1, further comprising an update control unit which supervises a **distribution process executed by a load balance** control unit of the final stage and updates **distribution conditions used in all the load balance** control units when distribution destinations of the input information by the **load balance** control unit of the final stage concentrates into a specific network **processor**.

Claims Text - CLTX (4):

3. The **load balancer according to claim 1, wherein each of the load balance** control units of the second and subsequent stages that is executing a distribution process with regard to the input information distributed to the specific network **processor by the load balance** control unit of the previous stage stops the distribution process when a concentration of the distribution destinations of the input information by the **load balance** control unit of the previous stage is solved.

Claims Text - CLTX (5):

4. The **load balancer according to claim 1, wherein each of the load balance** control units distributes the input information received from the receiving means to a predetermined network **processor** without executing the distribution processes.

Claims Text - CLTX (6):

5. The **load balancer according to claim 1, wherein each of the load balance** control units changes, when a failure caused on one of the **plurality of network processors,** a distribution conditions used on the distribution process into alternative distribution condition corresponding to distribution destinations except for the network **processor** having the failure.

Claims Text - CLTX (7):

6. A communication device comprising a load balancer including: receiving means; a **plurality of network processors** for performing processes for input information received by the receiving means; and a plurality of **load balance** control units that are multistage-connected in series with each other, wherein each of the **load balance** control units receives the input information from the receiving means and executes distribution processes for distributing the input information to one of the network **processors** according to a predetermined distribution condition per input information, and each of the **load balance** control units of the second and subsequent stages supervises a **distribution process executed by the load balance** control unit of the previous stage, and distributes, when distribution destinations of the input information by the **load balance** control unit of the previous stage concentrates into a specific network **processor,** the input information distributed to the specific network **processor by the load balance** control unit of the previous stage to alternative network **processor** according to a distribution condition different from the **distribution condition used in the load balance** control unit of the previous stage.

Claims Text - CLTX (9):

8. The communication device according to claim 6, further comprising display means for displaying at least one of **distribution conditions used in the load balance** control units which execute the distribution processes,

distribution states of input information to the network **processors,** and the number of **load balance** control units set in such states that the distribution processes are executed.

Claims Text - CLTX (10):

9. A communication device comprising: receiving means; a **plurality of network processors** for performing processes for input information received by the receiving means; and a plurality of **load balancers, wherein each of load balancers includes a plurality of load balance** control units that are multistage-interconnected in series with each other, each of the **load balance** control units receives the input information from the receiving means and executes distribution processes for distributing the input information to one of the network **processors** according to a predetermined distribution condition per input information, each of the **load balance** control units of the second and subsequent stages supervises a **distribution process executed by the load balance** control unit of the previous stage, and distributes, when distribution destinations of the input information by the **load balance** control unit of the previous stage concentrates into a specific network **processor,** the input information distributed to the specific network **processor by the load balance** control unit of the previous stage to alternative network **processor** according to a distribution condition different from the **distribution condition used in the load balance** control unit of the previous stage, and when one of the **load balancers** is used as an active-system and the other **load balancers** serve as standby-systems, distribution conditions which are being used in the plurality of **load balance** control units included in the **load balancer** serving as the active-system are set in the **load balance** control units included in the **load balancers** serving as the standby-systems.